SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE

CHOICE BASED CREDIT SYSTEM

M.Sc. ELECTRONIC SCIENCE

(implemented from June 2019)

Structure of Course

Basic structure/pattern (Framework) of the proposed postgraduate syllabus for the two year integrated course leading to M.Sc. (Electronic Science) in the colleges affiliated to Savitribai Phule Pune University.

Course Structure includes 3 compulsory theory courses of 4 credits each, ! Elective Theory of 2 credits and 1 compulsory practical course of 4 credits as well for each semester

In addition to this, one optional theory course and one practical course of 2 credits each are to be chosen from the given list for optional course

M.Sc. Electronic Science - Course structure & Credits Distribution

M. Sc. Electronic Science(Semester 1)

Sr. No.	Course code	Title of paper	Number of units	Credits
1	ELUT111	Mathematical Methods in Electronics using C	04	4
2	ELUT112	Analog Circuit Design	04	4
3	ELUT113	Digital System Design	04	4
4	ELDT114	Elective Theory Course 1	02	2
5	ELUP115	Practical Course 2 (Compulsory Course)	12 Practical sessions	4
6	ELDP114	Practical Course 1 (Elective Subject 1)	6 Practical sessions	2
			Total Credits	**20**

Elective Course 1

Any one theory course of 2 credits with corresponding practical course of 2 credits

- **Basics of optical communication**
- **Fundamentals and applications of PIC microcontrollers**

M. Sc. Electronic Science (Semester 2)

Sr. No.	Course code	Title of paper	Number of units	Credits
1	ELUT121	Applied Electromagnetics, Microwaves and Antennas	04	4
2	ELUT122	Instrumentation and Measurement Techniques	04	4
3	ELUT123	Foundation of Semiconductor Devices	04	4
4	ELDT124	Elective Theory Course 2	02	2
5	ELUP125	Practical Course 4 (Compulsory Course)	12 Practical sessions	4
6	ELDP124	Practical Course 3 (Elective course 2)	6 Practical sessions	2
			Total Credits	**20**

Elective Course 2

Any one theory course of 2 credits with corresponding practical course of 2 credits

- **Fiber optic communication system**
- **Fundamentals and applications of AVR microcontrollers**

Detail Syllabus with Recommended Books

M.Sc. Electronic Science Part 1

SEMESTER 1

ELUT111: Mathematical Methods in Electronics using C (4 Credits)

Objectives:

1. To get familiar with role of differential equations in applied electronics
2. To know about mathematical tools and techniques for network analysis
3. To learn the methods of analysis for CT and DT signals and systems
4. To learn concept of mathematical modeling of simple electrical circuits
5. To solve mathematical methods using C programming
6. To learn various advanced features, graphics and interfacing
7. To learn concepts of object oriented programming in C++

Unit-1: Electronic Signals and Mathematical Tools for Circuit Analysis (15 hrs)

Signals: periodic, non periodic, Continuous Time (CT) and Discrete Time (DT), special electronic signals (impulse, unit step, sinusoidal, ramp, square wave, staircase) Laplace Transform (LT): definition, LT of standard electronic signals, inverse LT, methods of ILT (partial fraction method), properties of LT (shifting, linear, scaling), initial and final value theorem, Convolution theorm, LT of derivatives and Integrals, solution of DE using LT

Unit 2: Transfer functions and Z transform (15 hrs)

concept of Transient and steady state response of systems using transfer function, poles and zeros of transfer function and their significance, applications to simple passive filters such as Low Pass (LP), High Pass (HP)

Concept of transfer function of CT and DT systems, Laplace transformation of electrical circuits, two port network functions, time and frequency domain response Stability analysis of electronic circuits using Routh Herwitz Criterion and using pole zero analysis

Z-Transform (ZT): definition, inverse ZT (partial fraction and residue method), ZT of standard electronic signals, properties, difference equation and solutions using ZT

Unit-3: Differential Equations(15 hrs)

Differential Equation, Ordinary Differential Equations (ODE), DE and their occurrences in real life problems, linear differential equation with constant coefficients, partial DE, Introduction to coordinate systems (rectangular, cylindrical and spherical), method of separation of variables, General outline for solution of wave equation in Cartesian and cylindrical coordinate system, Bessel DE and zeros of Bessel function and their significance, solution of Laplace equation in spherical coordinate system

Unit 4: Advanced C programming(15 hrs)

C fundamentals: Introduction of high-level programming language, operators and its precedence, various data types in C, storage classes in C.

Control statements: Decision–making and forming loop in programs.

Arrays & pointers: handling character, arrays in C, pointers in C, advanced pointers, structure and union.

Functions: user defined function, pointer to functions.

Introduction to Embedded C

Text / Reference Books:

1. Advanced Engineering Mathematics, E. Kreyzig, John Wiley and Sons.
2. Network Analysis, G. K. Mittal, Khanna Publication.
3. Circuits and Networks Analysis and Synthesis, A. Sudhakar, Shyam Mohan and
4. S. Pilli, TMH.
5. Digital Signal Processing, S. Salivahan, A. Vallavraj and C. Gnanpriya, McGraw Hill.
6. Network Analysis, M. E. Van Valkenberg, PHI.
7. Network and Systems, Roy Choudhary, Wiley Eastern.
8. Microwave Devices and Circuits, Samuel Y. Liao, 3rd Edition, PHI, 2002.
9. Computer programming in C, V. Rajaraman, Pearson Education, 2nd edition, 2003.
10. The C programming language, Dennis Ritchie, Pearson Education, 2nd edition, 2003.
11. Object oriented programming in C++, Robert Lafore, Galgotia Publications.
12. Programming with C++, John Hubbard, Schaum Outline Series, Tata McGraw Hill.
13. Programming with C, Byron S. Gottfried, Schaum Outline Series, Tata McGraw Hill.

ELUT112: Analog Circuit Design (4 Credits)

Objectives:

1. To learn the characteristics and working of electronic devices
2. To study the various device models
3. To study the wideband and narrowband amplifiers using BJT
4. To develop skills in analysis and design of analog circuits
5. To study the designs of opamp applications

Unit-1: Basic Semiconductor Devices(15 hrs)

Practical diode characteristics (static and dynamic resistance), temperature effects, switching characteristics, diode breakdown, diode applications in wave shaping circuits

BJT construction and biasing, Operation, CC, CB and CB configurations Construction of JFET, types and its operation, parameters of JFET, JFET characteristics, comparison of BJT and JFET, JFET amplifiers

MOSFET, depletion and enhancement, biasing of MOSFET, applications

Unit-2: Frequency Response of Amplifiers(15 hrs)

BJT models and modeling parameters, equivalent circuits for CE, CB and CC configurations, single stage amplifier, small signal analysis, distortion

Design of single stage RC-coupled amplifier with frequency response (f1 and f2) Frequency Response: Low and High frequency equivalent circuit, bode plots, Miller effect, square wave testing, frequency response of multistage amplifiers, different coupling schemes and gain of multistage amplifiers

Unit-3: Tuned Amplifier and Oscillators(15 hrs)

Tuned amplifier design, multistage tuned amplifiers: synchronous and stagger tuning cascade configuration, large signal tuned amplifier

Oscillators: design and analysis of LC and RC oscillators, Hartley, Colpitt's, Miller oscillators, phase shift and Wien-bridge oscillators, crystal oscillators and applications

Unit-4: Operational Amplifiers and their Applications(15 hrs)

Practical consideration in opamp based circuit design, opamp parameters such as dc and low frequency parameters and their significance in design of opamp, closed loop stability analysis and frequency compensation.

Inverting and non-inverting amplifiers with design aspects such as input and output impedance, common mode errors and limitations, bandwidth, etc.

Bridge and instrumentation amplifier

Practical design aspect of integrator and differentiators, such as offset error and stability, bandwidth considerations.

Concept and applications of PLL.

Active Filters: transfer functions poles and zeros, Design of active filters - LPF, HPF, BPF and BRF (first and higher orders), Butterworth and Chebyshev filters.

Text / Reference Books:

1. Electronic Devices and Circuits, S. Salivahanan, N. Suresh Kumar, 3rd Edn, McGraw Hill.
2. Electronic Devices and Circuit Theory, Robert Boylestead, Louis Nashelsky, PHI.
3. Design with Operational Amplifiers and Linear IC, Sergio Franco, 3rd Edn, TMH.
4. Electronic Principles, Malvino and Bates, McGraw Hill.
5. Operational amplifier, G.B.Clayton, Elsevier Sci. Tech.
6. Microelectronic Circuits: Analysis and Design, Mohammad H. Rashid, PWS Publishing Company.
7. Pulse, Digital Switching Circuits, Millman Taub, TMH.
8. Electronic devices, Allen Motershed, PHI.
9. Integrated electronics, Millman Halkies, McGraw Hill.

ELUT113: Digital System Design(4 Credits)

Objectives:

1. To understand sequential and combinational logic design techniques
2. To introduce VERILOG
3. To learn various digital circuits using VERILOG
4. To learn PLD, CPLD, FPGA and their applications

Unit-1: HDL for Digital System Design(15 hrs)

VERILOG: design flow, EDA tools, data types, modules and ports, operators, gate- level modeling, data flow modeling , behavioral modeling, tasks and functions, timing and delays, test bench, types of test bench, comparison between VERILOG and VHDL language

Unit-2: Combinational Logic(15 hrs)

Introduction to combinational circuits, realization of basic combinational functions - magnitude comparator, code converters, multiplexers, demultiplexers, multiplexed display, encoder and decoders, priority encoders, parity generator/checker, arithmetic circuits (adder, subtractor, binary multiplier), parallel adder, look ahead carry generator

VERILOG models and simulation of above combinational circuits

Unit-3: Sequential Logic Design and Circuits(15 hrs)

Introduction to sequential circuits

Flip Flops: types, state table, transition table, excitation tables, timing waveforms, clock generators

Counters: synchronous, asynchronous, design of counters, up/down counter Shift Registers: ring counter, Johnson counter

Finite State Machine (FSM) Design: Mealy and Moore state machines

VERILOG Models and Simulation of above Sequential Circuits and FSMs: stepper motor controller, traffic light control, washing machine control, parking controller, coffee vending machine, LCD controller

Unit-4: PLDs and Memories(15 hrs)

Need of PLD, antifuse, architecture of simple PLD (SPLD)-PAL, PLA, Complex Programmable

Logic Device (CPLD) and Field Programmable Logic Devices (FPGA) CPLD/FPGA based system design applications - typical combinational and sequential system implementation, estimation of uses of blocks, links, LUTs, etc.

Memories: types, data storage principle, control inputs, and timings, applications, Random Access Memories (RAM), Static Ram (SRAM), standard architecture, 6 transistor cell diagram, sense amplifier, address decoders, timings, Dynamic RAM (DRAM), different DRAM cells, refresh circuits, timings, role of memories in PLD

Text / Reference Books:

1. Verilog HDL; A Guide to Digital Design and Synthesis, Samir Palnitkar, Pearson Education, 2^{nd} edition, 2003.
2. Verilog HDL synthesis; A Practical Primer, J. Bhaskar, Star Galaxy Publishing, 1998.
3. Digital System Design with VERILOG Design, Stephen Brown, Zvonko Vranesic, TMH, 2^{nd} Edn, 2007.
4. Digital design; Principles Practices, Wakerly, PHI.
5. Modern Digital Electronics, R.P Jain, McGraw Hill.
6. Digital systems; Principles and Applications, Tocci, Pearson Education.
7. Digital Logic and Computer Design, Morris Mano, PHI.

ELDT114: BASICS OF FIBER OPTIC COMMUNICATION (2 Credits)

Elective Theory Course 1

Objectives:

1. To understand basics of optical fiber
2. To know about the types of optical fibers
3. To understand fiber optic communication system

Unit – I Fundamentals of optical fiber communication system(15 hrs)

Overview of basics of optical fiber: Total internal reflection. Ray model: Fundamental laws of optics , refraction, Snell's law, critical angle, total internal reflection Ray propagation in step index fiber , Numerical Aperture and acceptance angel , Definition of Skew rays and Meridional rays , Wave model :Phase velocity and group velocity , Modes in optical fiber , V-number & normalized frequency Classification of Optical fiber used in industry: Types of Optical Fiber: SI and GI , SM and MM

Types of losses in Optical fiber: Attenuation, Absorption losses: intrinsic and extrinsic , Linear scattering losses: rayleigh and mie , Fiber bend losses: micro and macro. Dispersion: Intermodal Dispersion in multi mode step index fiber , Intra-modal (Chromatic) Dispersion: material and wave guide dispersion. Dispersion shifted and dispersion flattened fibers

Unit II: Components of Fiber optics communication system (15 hrs)

Advantages & disadvantages , General configuration of Fiber optic communication system , Understand driver circuits used in Optical communication system LED driver circuit: Analog, Digital , LASER driver circuit: analog, digital , Optical receiver block diagram Common source FET preamplifier ,Regenerative repeater

Fiber optic cables : Needs of cabling , Fiber Cables: Slotted core, loose tube and multi-fiber ribbon Splicing and joining of fibre cable ,Connection losses: Extrinsic Parameters: Fresnel reflection, Misalignment, and Other factors, Intrinsic Parameters: NA mismatch, diameter mismatch, Fiber end preparation for loss minimization.

Splices: Fusions Splices ,Mechanical splices: Capillary, V-grooved, Loose tube, Spring groove and elastomeric splices.

Process of Connecting the fibre cable with connectors: Fiber optic connectors: Ferrule, Expanded beam.

TEXT/REFERENCE BOOKS:

1 Optical Fiber Communication John M Senior Pearson

2 Fiber Optics & Optoelectronics R P Khare Oxford

3 Fiber Optic Communication D C Agarwal S Chand

4 Optical Fiber & Fiber Optic Communication Subir Kumar Sarkar S Chands

ELDT114: Fundamentals and applications of PIC microcontrollers (2 Credits)

Elective Course I

Unit I: PIC Architecture (15 hrs)

Introduction to PIC microcontrollers, PIC architecture, Concept of pipelining, RISC, I/O ports, timers/counters and other peripherals, memory mapping, Interrupt structure, Comparison of PIC with other microcontrollers and microprocessors

Unit II: Programming and interfacing (15 hrs)

Instruction set; addressing modes, assembly language programming, Programs for bit manipulation, generation of delay and wave forms. PWM control etc. Hardware interface for LEDs, 7segment display, LCD, Keypad interfacing, dc and stepper motor.

TEXT/REFERENCE BOOKS

1. Programming PIC microcontrollers with PIC basic by Chuck Helebuyck
2. PIC microcontrollers-programming in basic by Milan Verle.

SEMESTER II

ELUT121: Applied Electromagnetics, Microwaves and Antennas(4 Credits)

Objectives:

1. To introduce to students the concepts of electromagnetics
2. To understand the theory of transmission lines and wave guides
3. To study various parameters of antennas
4. To study various methods of generation of microwaves

Prerequisite: Physical quantities as vectors, concept of gradient, curl, and divergence, concept of rotation operator, covariant and contra-variant vectors, line, surface and volume – integrals, Gauss and Stokes theorem complex plane, polar form of complex number, complex functions, Cauchy-Riemann conditions, orthogonal functions and relation with Laplace equation

Unit-1: Electromagnetic Waves(15 hrs)

Review of Maxwell's equations and their meaning, continuity equation, electric and magnetic wave equations in time domain and frequency domain, wave propagation in conducting and non-conducting media, skin depth and high frequency propagation, boundary conditions at the interface between two mediums, Poynting theorem and its applications

Unit-2: Transmission Lines(15 hrs)

Types of transmission lines, microstrip lines, two wire transmission line, transmission line equations for voltages and currents, inductance and capacitance per unit length of two wire and coaxial cable transmission line, characteristic impedance, propagation constants, attenuation and phase constants, phase velocity, reflection and transmission coefficients, SWR, line impedance, normalized impedance and admittance, Smith chart construction and applications, single stub and double stub matching, applications to reflection of EM-waves at interfaces for normal incidence

Unit-3: Waveguides and Components(15 hrs)

Concept of waveguides, frequency range, relation to transmission lines

Rectangular Waveguides: TM and TE Modes, concept of cut-off frequency, guide impedance,

phase velocity, guide wavelength for TE and TM modes, Applications to TE mode in rectangular waveguide, power losses in rectangular waveguide
Circular waveguide introduction only
Optical Fiber: principles of operation and construction, difference between conducting circular waveguide and fiber
Different methods of excitation of TE and TM modes in waveguides Cavity Resonators, Q factor of cavity resonators

Unit-4: Electromagnetic Radiation(15 hrs)

Potentials of electromagnetic fields, retarded potential, radiation from oscillating dipole, concept of near zone and radiation zone, radiation resistance, role of antenna in exciting different TE, TM modes in wave guides
Antenna Parameters: gain, directivity, power, aperture, Friis equation, radiation pattern
Application Areas: antenna temperature, Signal to Noise Ratio (SNR), remote sensing, RADAR equation
Antennas Types: λ/2 antenna, antenna arrays, horn antennas, parabolic dish antennas, End fire antenna – Yagi Uda, patch antenna, microstrip antennas EMI and EMC
Generation of Microwaves: principle, physical structure and working of - Gunn effect diodes, magnetron oscillator, reflex Klystron oscillator

Note: In the case of antennas and microwave devices, mathematical analysis of equivalent circuits and processes is not expected.

Text / Reference Books:

1. Microwave Devices and Circuits, Samuel Y. Liao, PHI, 3rd Edition, 2002.
2. Principles of Electromagnetics, N. Sadiku, Oxford University Press.
3. Electromagnetics with Applications, Kraus and Fleiseh, McGraw Hill, 5th Edn, 1999.
4. Electromagnetics, J.D. Kraus, 4th Edn, McGraw Hill, 1992.

ELUT122: Instrumentation and Measurement Techniques

Objectives:

1. To understand the configurations and functional descriptions of measuring instruments
2. To understand the basic performance characteristics of instruments
3. To understand the working principles of various types of sensors and transducers and their use in measuring systems
4. To study the techniques involved in various types of instruments
5. To understand the relevance of electronics with other disciplines

Unit-1: Introduction to Measurement and Measurement Systems(15 hrs)

Definition and significance of measurement, classification of instruments and types of measurement applications, elements of an instrument / measurement system, active and passive transducers, analog and digital modes of operation, null and deflection methods, input-output configuration of instruments and measurement systems, methods of correction of instruments and measurement systems Generalized performance characteristics of instruments: static characteristics and static calibration, meaning of static calibration, true value, basic statistics, least–squares calibration curves, calibration accuracy versus installed accuracy, combination of components errors in overall system accuracy calculations, theory validation by experimental testing

Unit-2: Static Dynamic Characteristic of Measurement System(15 hrs)

Static sensitivity, linearity, threshold, noise floor, resolution, hysteresis and dead space, scale readability, span, generalized static stiffness and input impedance, loading effect

Dynamic characteristics: generalized mathematical model of measurement system, operational transfer function, sinusoidal transfer function, zero-order instrument, first order instrument, second order instruments, step response, ramp response, frequency response of first -order instruments and second order instruments

Errors in measurement: Types of Errors - gross, systematic, environmental errors, systemic errors, computational error, personal error etc.

Unit-3: Motion Measurement(15 hrs)

Methods of transduction, primary sensing elements and transducers, electrical transducers, classification of transducers

Motion and dimensional measurement: fundamental standards, relative displacement-translational and rotational, calibration, resistive potentiometers, resistance strain gauge, differential transformers, variable–inductance and variable– reluctance pickups, eddy current, non contacting transducers, capacitance pickups, piezoelectric transducers, digital displacement transducers (translational and rotary encoders), ultrasonic transducers, detailed discussion of strain gauges, LVDT and synchros

Relative velocity: translational and rotational, calibration, average velocity from measured □x and □t, tachometer encoder methods, laser based methods, stroboscopic methods, translational–velocity transducers (moving coil and moving magnet pickups)

Relative acceleration measurements: seismic (absolute) displacement pickups, seismic (absolute) velocity pickups, seismic (absolute) acceleration pickups (accelerometers)

Unit-4: Process Parameter Measurements(15 hrs)

Force, Torque and Shaft power: standards and calibration, basic methods of, bonded strain gauge, differential transformer, piezoelectric, variable reluctance/ FM oscillator digital system, torque measurement on rotating shafts

Pressure and Sound Measurement: standards and calibration, dead weight gauges and manometers, low pressure measurement - Mcleod gauge, Knudsen gauge, viscosity, thermal conductivity, ionization, sound level meter, microphone, capacitor microphone

Flow measurement: Pitot-static tube, Yaw tube, hot wire and hot film anemometers, Laser Doppler anemometer, Gross Volume Flow Rate- rotameter, turbine, ultrasonic flow meter, electromagnetic flow meters

Temperature and Heat Measurement Transducers: standards and calibration, bimetallic thermometers, liquid in glass thermometers, pressure thermometers, RTD, thermocouples, thermistors, semiconductor based temperature sensors, detailed discussion on basics of thermocouples, laws of thermocouples, cold junction compensation; thermistor types, materials used, application circuits, LM35

Radiation Fundamentals: detectors, optical pyrometers, IR imaging systems, heat flux sensing-slug type sensors, Gorden gauge

Text / Reference Books:

1. Measurement Systems, Applications and Design, Ernest O. Doeblin and Dhanesh N. Manik, 5th Edition, Tata McGraw Hill.
2. A Course in Electrical and Electronic Measurements and Instrumentation by A.K. Sawhney, Dhanpat Rai & Co.
3. Electronic Instrumentation, Kalsi, TMH.
4. Modern Electronic Instrumentation and Measurements Techniques, Cooper and Helfrick, PHI.

ELUT123: Foundation of Semiconductor Devices(4 Credits)

Objectives:

1. To introduce crystal structure with reference to semiconductors
2. To introduce quantum and statistical mechanics
3. To understand the characteristics of semiconductor devices
4. To introduce theory of diode, transistor and FETs

Unit-1: Theory of solids(15 hrs)

Crystal structure of solids: Semiconductor materials, types of solids, basics of crystallography, space lattice atomic bonding, unit cell, Miller indices imperfections and impurities in solids, methods for semiconductor crystal growth.

Unit 2: Introduction to Quantum and statistical Mechanics(15 hrs)

Principles of quantum mechanics, Schrodinger wave equation, and Applications of Schrodinger's wave equation for bound state potential problems.

Introduction to quantum theory of solids: Allowed & forbidden energy bands, electrical conduction in solids, extensions to three dimensions, density of states, Statistical mechanics: Statistical laws, Fermi-Dirac probability function, the distribution function and the Fermi energy

Unit-3: Physics of semiconductors(15 hrs)

Semiconductor in equilibrium: Charge carriers in semiconductors, dopant atoms and energy levels, extrinsic semiconductors, Statistics of donors and acceptors, charge neutrality, position of Fermi energy level.Carrier transport phenomena: charge, effective mass, state & carrier distributions ,Carrier drift, carrier diffusion, graded impurity distribution, resistivity, Hall effect.

Non-equilibrium excess carriers in semiconductors: Carrier generation and recombination, characteristics of excess carriers, bipolar transport, quasi-Fermi energy levels, excess carrier lifetime, surface effects

Unit-4: Basics of Semiconductor Devices(15 hrs)

Diode: Junction terminologies, Poisson's equation, built-in potential, depletion approximation, diode equation, Qualitative and Quantitative analysis, Reverse-bias breakdown, avalanching, zener process, C-V characteristics, Transient response .

BJT: Terminology, electrostatics and performance parameters, Eber-Moll model, Two port

model, hybrid – pi model, device models in spice , Modern BJT structures –polysilicon emitter BJT, Heterojunction bipolar transistor (HBT)
FETs: JFET and MESFET - Junction terminologies, characteristics, ac response,spice models
MOSFET: Fundamentals, Capacitance- voltage characteristics, I-V characteristics, Qualitative Theory of Operation, ID - VD Relationship, ac response, spice models.

Text / Reference Books:

1. Semiconductor Physics and Devices Basic Principles, Donald A. Neamen, TMH, 3rd Edition (2003)
2. Semiconductor Device fundamentals, Robert F. Pierret, Pearson Education
3. Solid State Electronics Devices, Streetman, PHI, 5th Edition, (2006)

ELDT124: FIBER OPTIC COMMUNICATION SYSTEM (2 Credits)

Elective Course 2

Objectives:

1. To understand types of optical cables, connectors etc
2. To understand integrated optics and their components
3. To understand design of optical fiber communication system

Unit – I Optical Fiber Cables , connectors and integrated optics(15 hrs)

Optical components & Integrated optics Optical couplers and isolators: types and functions ,Optical switches , Beam splitter, Optical multiplexer and demultiplexer ,Optical wavelength converter , Bragg grating , working of optical amplifier

Understand concept of Integrated optics: Optical Amplifiers-Semiconductor optical amplifier, EDFA, Raman amplifier ,

Concept of Integrated optics Characterization & Applications working principle of Optical Power Meter & OTDR, Optical power meter ,Optical time domain reflectometer ,

Understand application of WDM in Fibre optics communication system ,WDM & DWDM

Fiber Sensors ,List application of various LASER used in industries & medical surgery.

Unit II: Optical System Design: Considerations(15 hrs)

Component Choice, Multiplexing, Point-to- Point Links, System Considerations, Link Power Budget with Examples, Overall Fiber Dispersion In Multi-Mode and Single Mode Fibers, Rise Time Budget with Examples. Transmission Distance, Line Coding in Optical Links, WDM, Necessity, Principles, Types of WDM, Measurement of Attenuation and Dispersion, Eye Pattern.

TEXT/REFERENCE BOOKS:

1 Optical Fiber Communication John M Senior Pearson

2 Fiber Optics & Optoelectronics R P Khare Oxford

3 Fiber Optic Communication D C Agarwal S Chands

4 Light wave Communication Systems: A Practical Perspectives Rajappa Papannareddy Penram

5 Optical Fiber & Fiber Optic Communication Subir Kumar Sarkar S Chands

ELDT124: Fundamentals and applications of AVR Microcontroller (2 Credits)

Elective Course 2

Objectives:

1. To understand the architecture, assembly language and interfacing of AVR
2. To learn embedded C programming
3. To learn software techniques to embed codes in to the systems

Unit-1: Introduction to AVR Microcontroller (15 hrs)

Architecture (Atmega16), instruction set, addressing modes, memory organization, timers, PWM, I/O ports, ADC, interrupts, serial communication. Basic Assembly Programs: arithmetic, logical, code converter, block data transfer, I/O programming for ADC, timer and I/O ports

Unit-2: Applications of AVR Microcontroller (15 hrs)

Design of General Purpose Target Board: reset, oscillator circuit, derivatives of AVR,
Real world interfacing with the microcontrollers and programming in C for interfacing LED, Seven Segment Display, dot matrix display and LCD displays (text and graphic), keyboard and motors (DC, stepper, and servo), I2C and SPI based RTC, EEPROM, DAC and ADC,

Text / Reference Books:

1. AVR Microcontroller and Embedded Systems using Assembly and C, Mazidi and Naimi, Pearson education, 2011.
2. Embedded C Programming and the Atmel AVR, Barnett, Larry D. O’Cull and Sarah A. Cox, Delmar, Cengage Learning, 2007.
3. PIC Microcontroller and Embedded Systems, Mazidi, Mckinlay and Causey, Pearson Education.
4. C Programming for Embedded Systems, Kirk Zurell, Pearson Education.
5. Programming in C, Stephen Kochan, Hayden Books/Macmillan.

ELDP114: PRACTICAL COURSE I(2 Credits)

Elective course 1(Basics of optical communication system)

List of practical's (Any 6)

1. Measurement of Numerical Aperture of optical fiber
2. Measurement of attenuation of given optical fiber
3. Measurement of bending loss of given optical fiber
4. To Plot characteristics of LED
5. To Plot characteristics of LASER diode
6. To Plot characteristics of Photo Diode
7. To Demonstrate various fiber cables
8. To demonstrate fiber end preparation process.
9. To Demonstrate Splicing Techniques
10. To Demonstrate various connectors

ELDP114: Practical Course I(2 Credits)

Elective Course 2 (Any 6)

Practical's on PIC Interfacing

1. Two-digit 7-segment display(multiplexed) interfacing
2. LCD / keyboard Interfacing
3. Bidirectional stepper motor interfacing
4. Real Time Clock display on LCD / HyperTerminal (I2C)
5. Use of internal EEPROM
6. DAC interfacing (square wave, staircase, triangular, sine) use of timer for
7. On-off controller with hysteresis (ADC)
8. Two digit frequency counter or event counter using timer / interrupt
9. Matrix keyboard / Touch screen
10. Graphic LCD interfacing
11. Zigbee communication
12. DC motor control using PWM / intensity control of LED

ELUP115: Practical Course –II (4 Credits)

Compulsory Course(Any 12 Practical's)

A. Practical based on Circuit Design

1. Bootstrap ramp generator for delay triggering
2. Blocking oscillator
3. Tuned amplifier small signal / large signal for IF
4. Transistor based microphone amplifier
5. Voltage controlled current source / sink and current mirror and doubler
6. Comparator and Schmitt trigger with single supply operation
7. Second order Butterworth filters (BP and BR)
8. Waveform generation: quadrature oscillator, Bubba oscillator
9. V to f and f to V using commercially available IC
10. Instrumentation amplifier for a given gain
11. Low current negative power supply using IC555 / dual power supply using single battery
12. PLL characteristics and demonstrate any one application (IC565/CD4046)

B. Practical based on Digital Design

1. Two digit combinational lock
2. Keyboard encoder with latches
3. Traffic light controller
4. Multiplexed display (Bank token / two digit counter)
5. Bidirectional stepper motor control (Sequence Generator)
6. One digit BCD adder and 8-bit adder / subtractor
7. Object counter (use of MMV, counter)
8. Binary-Gray and Gray-Binary code converter

C. Practical Based on VERILOG Programming and Implementation on CPLD or FPGA

1. Combinational Logic
2. Parity Generator and checker
3. Hamming Code Generator
4. Manchester code Generator
5. Sequential Logic
6. Up-down bit binary counter (minimum 4-bit)
7. Universal shift register

8. Four bit ALU design (structural modelling)
9. Keyboard Scanning
10. Designing of Traffic light Controller
11. Implementation of 8 bit multiplexer
12. LCD controller
13. Code Converter (BCD to seven Segment)
14. Practical based on state machine (Stepper sequence generator/Vending Machine/ Washing Machine)
15. Barrel shifter

D. Practical based on C / MATLAB / PSPICE

1. Phase and frequency response from transfer function of a CT system: Low Pass and High Pass
2. Phase and frequency response from transfer function of a DT system: Low Pass and High Pass
3. Transient and steady state response of CT system: LCR series circuit with different inputs
4. Simulation of transfer function using poles and zeros
5. Synthesis of periodic waveform from Fourier coefficients
6. Solution of differential equation with given boundary conditions
7. Analysis of a given dc electrical circuit
8. Effect of locations of poles and zeros on the transfer function and corresponding frequency response

ELDP124: PRACTICAL COURSE I(2 Credits)

Elective course 1 (Fiber optic communication systems)

List of practical's (Any 6)

1. To establish Analog communication optical link
2. ToI establish Digital communication optical link
3. To Build and test LED drive circuits
4. To Demonstrate OTDR
5. To Demonstrate Optical Power Meter.
6. To Build fibre optics link using PAM technique
7. To Build fiber optics link using TDM technique
8. Following is the list of proposed student activities like:
   - Visit nearby fiber optics industries.
   - Hands on training on fibre connecterization.
   - Arrange visit to BSNL to see live circuits and measurement of parameters
   - Collect information of transatlantic optical network used for communication.
   - Visit any Campus Wide area network which uses optical fiber .
   - Explore use of lasers in medical treatment

List of Major Equipment/Materials

1. OTDR
2. Optical power meter
3. CRO
4. Fusion splicing machine
5. Optical fiber : Glass,Plastic
6. Semiconductor laser

ELDP124: Practical Course I(2 Credits)

Elective Course 2(Any 6)

Practical on AVR

1. Interfacing of LED array to generate different sequences,
2. use of timer for delay generation
3. Matrix Keyboard interface with LCD
4. DAC interfacing (sine, staircase, triangular, square wave) use of timer
5. Use of ADC
6. DC motor control using PWM / Intensity control of LED – with CCP
7. Serial EEPROM / EEPROM interface using SPI protocol
8. Real time clock (RTC)
9. Stepper motor Interfacing
10. Dot matrix rolling display

ELUP125: Practical Course III(4 Credits)

Compulsory Course(Any 12)

A. Practical based on Instrumentation and Measurement System

1. Design build and test rms to dc converter for voltage measurement of ac signal
2. Displacement measurement using LVDT, signal conditioning and DPM
3. Temperature measurement using PT100, signal conditioning and DPM
4. Temperature measurement using thermocouple with cold junction compensation
5. Design build and test IR transmitter and receiver (TSOP1738 or similar) for object detection
6. To build and test current telemetry (4 to 20 mA)
7. Ultrasonic transmitter and receiver, distance measurement
8. Pressure measurement using strain gauge
9. RPM measurement using various methods
10. Design and calibrate light intensity meter using photodiode or LDR and the necessary signal conditioning and display.
11. Use of strain gauge to measure stress on a cantilever made of material known quantity
12. Hot wire anemometer

B. Practical based on Electromagnetics, Microwaves, Antennas

1. To study the characteristics of Klystron tube
2. To determine the standing wave ratio and reflection coefficient of a given waveguide
3. To plot directivity pattern of a given antenna
4. To determine a characteristics of a microstrip transmission line
5. Design and test Yagi-Uda antenna with power reflectors
6. Measurement of primary-secondary coupling factor of a given transformer using LCR meter (calculation of transformer model parameters expected)

C. Practical on Electromagnetics (C / MATLAB)

1. To plot Equipotential contours and field lines for given charge distribution
2. Use of Smith chart for transmission line pattern and verify using C
3. Use of MATLAB for potential distribution in a region bound by two conductors
4. Use of MATLAB for directivity pattern for simple antennas