SAVITRIBAI PHULE PUNE UNIVERSITY,PUNE

T. Y. B. Sc. Electronic Science

Choice Based Credit System(CBCS)

Under Faculty of Science and Technology

(to be implemented from June 2021)

COURSE STRUCTURE OF T. Y. B. Sc. Electronic Science (CBCS)

TO BE IMPLEMENTED FROM JUNE 2021

Sem		Course Code	Paper	Paper title	credits
V	Discipline Specific Elective Course	EL 351	I	Digital Design using Verilog	2
		EL 352	II	Microcontroller Architecture and Programming	2
		EL 353	III	Analog circuit Design and Applications	2
		EL 354	IV	Nanoelectronics	2
		EL 355	V	Signals and Systems	2
		EL 356(A) EL 356(B)	VI	A. Optics and Fiber Optic Communication B. Electronic Product Design and Entrepreneurship	2
		EL 357	VII	Practical Course I	2
		EL 358	VIII	Practical Course II	2
		EL 359	IX	Practical Course III(Project)	2
	Skill Enhancement Course	ELSEC 351	X	Electronic Design Automation Tools	2
		ELSEC 352	XI	Internet of Things and Applications	2
VI	Discipline Specific Elective Course	EL 361	I	Modern Communication Systems	2
		EL 362	II	Embedded System Design using Microcontrollers	2
		EL 363	III	Industrial Electronics	2
		EL 364	IV	Manufacturing Processes for Electronics	2
		EL 365	V	Process Control Systems	2
		EL 366(A) EL 366(B)	VI	A. PLC SCADA B. Sensors and Systems	2
		EL 367	VII	Practical Course I	2
		EL 368	VIII	Practical Course II	2
		EL 369	IX	Practical Course III(Project)	2
	Skill Enhancement Course	ELSEC 361	X	Design and Fabrication of PCB	2
		ELSEC 362	XI	Mobile Application Development	2

Program Specific Outcomes of B.Sc. Electronic Science

The following program specific outcomes have been identified for B.Sc Electronic Science.

PSO1	Ability to apply knowledge of mathematics and science in solving electronics related problems
PSO2	Ability to design and conduct electronics experiments, as well as to analyze and interpret data
PSO3	Ability to design and manage electronic systems or processes that conforms to a given specification within ethical and economic constraints
PSO4	Ability to identify, formulate, solve and analyze the problems in various disciplines of electronics
PSO5	Ability to function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility
PSO6	Ability to communicate effectively in term of oral and written communication skills
PSO7	Recognize the need for, and be able to engage in lifelong learning
PSO8	Ability to use techniques, skills and modern technological/scientific/engineering software/tools for professional practices

PSO-CO mapping

Course title	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
Digital Design using Verilog		√	√	√				√
Microcontroller architecture and Programming		√	√	√				√
Analog circuit Design and applications	√	√	√	√				
Nanoelectronics				√	√			
Signals and Systems	√		√					
A. Optics and Fiber Optic Communication B. Electronic Product Design and Entrepreneurship			√	√	√			√
Practical Course I		√	√	√		√		√
Practical Course II		√	√	√		√		√
Practical Course III(Project)		√	√	√	√	√		√
SEC1: EDA Tools			√	√			√	√
SEC2: Internet of Things and applications		√	√				√	√
Modern Communication Systems	√	√	√		√			
Embedded System Design using Microcontrollers		√	√	√			√	√
Industrial Electronics		√	√	√			√	
Introduction to Electronics Manufacturing Processes			√		√		√	√
Process control systems	√		√				√	√
A. PLC SCADA B. Sensors and systems		√	√		√			√
Practical Course I		√	√	√		√		
Practical Course II		√	√	√		√		√
Practical Course III(Project)		√	√	√	√	√		√
Design and fabrication of PCB		√		√			√	√
Mobile application development			√	√			√	√

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Discipline Specific Elective Course

EL 351: Paper I: Digital Design using VERILOG

SEMESTER V **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to
CO1: Know and understand structure of HDL and Verilog.
CO2: Understand different modeling styles in Verilog.
CO3: Use Verilog effectively for simulation, verification and synthesis of digital system.
CO4: Understand basics of programmable logic devices.

UNIT 1: Introduction to Verilog (10 LECTURES)

A Brief History of HDL, Structure of HDL Module, Comparison of VHDL and Verilog, Introduction to Simulation and Synthesis Tools, Test Benches, Verilog Modules, Delays, data flow style, behavioral style, structural style, mixed design style, simulating design
Introduction to Language Elements: Keywords, Identifiers, White Space Characters, Comments, Format, Integers, Reals and Strings, Logic Values, Data Types-net types, undeclared nets, scalars and vector nets, Register type, Parameters, Expressions, Operands, Operators, types of Expressions

UNIT 2: Modeling Styles (12 LECTURES)

Data flow Modeling: Continuous assignment, net declaration assignments, delays, net delays.
Behavioral Modeling: Procedural constructs, timing controls, block statement, procedural assignments, conditional statement, loop statement, procedural continuous assignment
Gate level modeling: Introduction, built in Primitive Gates, multiple input gates, Tri-state gates, MOS switches, bidirectional switches, gate delay, array instances, implicit nets, Examples (both combinational and sequential logic circuits)

UNIT 3: Logic synthesis with Verilog (8 LECTURES)

Concept of logic synthesis, Synthesis design flow, Synthesis of combinational logic for two bit magnitude comparator, Synthesis of Sequential Logic with Flip-Flops

UNIT 4: Introduction to Programmable Logic Devices (6 LECTURES)

Introduction of Programmable Logic Array (PLA), Programmable Array Logic (PAL), Programmability of PLDs, Complex PLDs (CPLDs), Field-Programmable Gate Arrays

RECOMMENDED BOOKS:

1. Verilog HDL: A Guide to Digital Design & Synthesis, Samir Palnitkar, SunSoft Press, ISBN: 978-81-775-8918-4.
2. Digital Fundamentals, Floyd and Jain, Pearson Education, ISBN: 8177587633
3. Fundamental digital logic with Verilog design by Stephen Brown and Zvonka Vrenesic, Mc Graw Hill Publication, ISBN 0-07-282315-1 ISBN 0-07-121322-8 (ISE)

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EL 352: Paper II: Microcontroller Architecture and Programming

SEMESTER V **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to
CO1: Understand the basics of microcontroller.
CO2: Acquire basic programming skills in C language.
CO3: Understand and acquire basic programming skills for AVR microcontroller.

UNIT 1: Introduction to Microcontrollers (6 LECTURES)

Features of microcontroller, classification of microcontrollers, architectural variations in microcontrollers, Applications of microcontrollers

UNIT 2: Basics of C Programming (12 LECTURES)

Types of Programming languages, Algorithm, flowcharts, instructions, syntax, hex files, linkers, compilers, Basic data types, variables, Structure of C program, Operators in C, Arrays-concept, one, two-dimensional and multi-dimensional arrays, pointers, Input output statement, Decision making statements, Control loops, Functions: Library functions and user defined functions.

UNIT 3: AVR Programming using C (12 LECTURES)

Architecture of AVR, Data types for AVR, Time delay generation, I/O programming, Logic operations, Data conversion, Data serialization, Memory allocation in C, Programming Timers, Counters, serial port, interrupts

UNIT 4: Interfacing Peripherals to AVR (6 LECTURES)

LCD Interfacing, Keyboard interfacing, ADC interfacing, DAC interfacing, External memory interfacing, Stepper motor interfacing.

RECOMMENDED BOOKS:

1. The AVR microcontroller and embedded systems using Assembly and C, Muhamad ali Mazidi, Sarmad Naimi, Sepehr Naimi, PHI publications
2. Microcontrollers: Architecture, Programming, Interfacing and System Design, Rajkamal, Pearson India, ISBN: 9788131759905
3. Let us C, Yashwant Kanetkar, BPB Publications
4. Embedded Systems: Architecture, Programming & Design, Raj Kamal, Tata McGraw Hill publication

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EL 353: Paper III: Analog circuit Design and Applications

SEMESTER V **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to

CO1: Understand basics of analog circuit design.
CO2: Analyze waveform generators required for testing different circuits.
CO3: Build application circuits using specialized ICs.
CO4: Design analog systems using available ICs.

UNIT 1: Fundamentals of Analog Circuit Design (6 LECTURES)

Design specifications, selection of amplifier, unwanted signals, avoiding fault conditions, offset nullifying techniques, enhancing output capabilities.

UNIT 2: Nonlinear Circuits (10 LECTURES)

Logarithmic Amplifiers, Log/Antilog Modules, Precision Rectifier, Peak Detector, Sample and Hold Circuits. OP-AMP as Comparator, Schmitt Trigger, Monostable Multivibrator, Analog Multiplier applications

UNIT 3: Waveform Generators (12 LECTURES)

Wien-bridge and twin-T oscillators, Square wave generators, Ramp Generator, Triangular wave generator, Sawtooth wave generator, Sine wave generator, Crystal Oscillator,

Function Generators: Multi op-amp function generators, function generator IC's.

Phase Locked Loops: Block diagram and operation, Applications as Frequency Multiplier and Frequency Shift Keying

UNIT 4: Voltage Regulators (8 LECTURES)

Design of Power Supply: Voltage Regulator, Three terminal voltage regulators, Fixed and adjustable voltage regulators (78XX, LM317), Dual power supply (LM320, LM317), Basic switching regulator and its characteristics

RECOMMENDED BOOKS:

1. OP-AMP and Linear ICs, Ramakant A. Gayakwad, Prentice Hall / Pearson Education
2. Operational Amplifiers and Linear Integrated Circuits, Robert F. Coughlin, Frederick F. Driscoll, PHI
3. Operational Amplifiers, G. B. Clayton, Elsevier

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EL 354: Paper IV: Nanoelectronics

SEMESTER V **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to
CO1: Understand basic concepts of nano electronic devices and nano technology.
CO2: Understand the electron transport mechanism in nanostructures.
CO3: Understand techniques of characterization of nanostructures.
CO4: Understand different devices constructed using nanotechnology.

UNIT 1: Introduction to Nanotechnology and Nanoelectronics (5 LECTURES)
Overview of basic Nano electronics, Limitations of conventional microelectronics, Top down approach, Bottom up approach, Flash Memory, Applications of nanotechnology in nanoelectronics. Introduction to metamaterials

UNIT 2: Electron Transport in Nanostructures (5 LECTURES)
Resonant-tunneling diode, electrons in square quantum wells of finite depth, electrons in quantum wire, electrons in quantum dots, Density of states of electrons in nanostructures

UNIT 3: Characterization of Nanostructures (12 LECTURES)
Introduction to characterization of nanostructures: Principle of operation of Scanning electron microscope (SEM), Transmission Electron Microscope (TEM), Scanning Tunneling Microscope (STM), X-Ray Diffraction analysis (XRD), UV-Vis absorption Spectrum

UNIT 4: Materials for Nanoelectronics and Devices (14 LECTURES)
Materials: Semiconductors nanoparticles, Organic semiconductors, Lattice-matched and pseudomorphic heterostructures, Inorganic nanowires, Carbon nanomaterials: nanotubes and fullerenes
Devices: Coulomb Blockade, The Single-Electron Transistor (SET), Carbon Nanotube Transistors (CNT), Semiconductor Nanowire, Quantum well laser, quantum dot LED, quantum dot laser, MOSFETS

RECOMMENDED BOOKS:
1. Nanotechnology: Principles and Practices, Sulbha K. Kulkarni, Springer 2008
2. Introduction to Nanoelectronics Science, nanotechnology, Engineering and Applications, V. Mitin ,Viatcheslav A. Kochelap , Michael A. Stroscio Vladimir, Cambridge University Press 2008

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EL 355: Paper V: Signals and Systems

SEMESTER V **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to
CO1: Know basics of electronic signals.
CO2: Know different types of systems.
CO3: Analyze systems using Laplace and Fourier analysis.
CO4: Understand digital signal processing system.

UNIT 1: Fundamentals of Electronic Signals (4 LECTURES)

Definition, Classification of signals: CT and DT, Periodic and aperiodic, Even and odd signals
Elementary signals: unit step, unit impulse, unit ramp, exponential and sinusoidal signals

UNIT 2: Types of Systems (8 LECTURES)

Definition: Systems, Continuous Time systems, Discrete time systems, Static and dynamic systems, Time variant and time invariant systems, linear and nonlinear systems.

UNIT 3: Laplace Transform and Fourier Analysis (14 LECTURES)

Laplace transform: Definition, Properties, LT by using standard tables, First shifting theorem, Second shifting theorem, LT of Differential equation and integral, Convolution theorem
Inverse Laplace transform: Definition, ILT by standard tables, ILT by partial fractions
Fourier Analysis: Definition, Fourier series and Formulae for Fourier Coefficients, Fourier series analysis of periodic signals such as square wave, triangular wave, half wave rectifier

UNIT 4: Digitization of Analog Signals (10 LECTURES)

Analog to Digital conversion of signals, concept of sampling of CT signals, Shanon's Sampling Theorem, Nyquist frequency, Aliasing effect, oversampling and antialiasing filters, concept of quantization and quantization error, encoding, Introduction to DSP systems

RECOMMENDED BOOKS:

1. Network Analysis: G. K. Mittal, Khanna Publishers
2. Signals and systems by J. S. Chitode, Technical publications
3. Digital Signal Processing: S. Salivahan, A. Valuraj, C. Gnanapriya, Tata McGraw Hill Publications
4. Digital Signal Processing: - Principles, Algorithms and Applications: John G Proakis, Dimitris G Manolakis, Pearson Publications

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EL 356(A): Paper VI(A): Optics and Fiber Optic Communication

SEMESTER V **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to

CO1: To acquire Knowledge of optical fiber communication system.

CO2: To understand different parameters of optical fibers.

CO3: To learn essential optical components of Fiber Optic Communication.

CO4: To analyze and integrate fiber optical network components in variety of networking schemes.

UNIT 1: Overview of Optics and Optical Fiber Communication (14 LECTURES)

History of fiber optic systems, block diagram, Fiber material, fiber cables and fiber fabrication, fiber joints, fiber connectors, splicer, Propagation of light in optical fiber, acceptance angle, numerical aperture, Types and specification of optical fiber, Advantages of optical fiber communication, applications

UNIT 2: Transmission Characteristics of Optical Fiber (8 LECTURES)

Attenuation, absorption, linear and nonlinear scattering losses, bending losses, modal dispersion, waveguide dispersion and pulse broadening, Dispersion shifted and dispersion flattened fibers, Measurement of optical parameters, attenuation and dispersion

UNIT 3: Optical Sources and Detectors (8 LECTURES)

Sources: Coherent and non-coherent sources, quantum efficiency, modulation capability of optical sources, Working principle and characteristics of - LEDs, Laser diodes, Modulation in laser diodes, Detectors: PIN and APD, Noise analysis in optical detectors

UNIT 4: Optical Networks (6 LECTURES)

Architecture of optical transport networks (OTNs), network topologies, Introduction to Synchronous optical networking (SONET) and synchronous digital hierarchy (SDH).

RECOMMENDED BOOKS:

1. Optical fiber communication – Principles and practice, J.M. Senior, PHI
2. Fiber optics and Optoelectronics, R.P. Khare, Oxford University Press
3. Optical fiber communication, G. Kaiser McGraw Hill

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EL 356(B): Paper VI(B): Electronic Product Design and Entrepreneurship

SEMESTER V **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to
CO1: Know of fundamental steps of electronic product design.
CO2: Know about product debugging and testing techniques.
CO3: Understand different types of documentation procedures required for product design.
CO4: Understand basic requirements for entrepreneurship.

UNIT 1: Introduction to Electronic Product Design (6 LECTURES)
Stages in Product Design, Five elements of successful product design, Prototyping of Product, Ergonomics

UNIT 2: Product Debugging and Testing (10 LECTURES)
Steps of debugging, Techniques of troubleshooting, characterization, Inspection and testing of components, Simulation and prototyping, Integration, Verification and validation, EMI and EMC issues

UNIT 3: Documentation (10 LECTURES)
Types of documentation, Presentation and preservation, Methods of documentation: Technical presentations, Proposals, Visual Techniques, Layout of documentation, Bill of Materials (BOM)

UNIT 4: Entrepreneurship Development (10 LECTURES)
Definition, Characteristics of an Entrepreneur, Functions of Entrepreneur, types of Entrepreneur, Motivation factors to become Entrepreneur, Entrepreneurial competencies, Entrepreneur and economic Development

RECOMMENDED BOOKS:

1. Electronic Product Design, V. S. Bagad, Technical Publications
2. Entrepreneurship Development, E. Gordan and K. Natarajan, Himalaya Publishing House, New Delhi
3. Electronic Product Design, R. G. Kaduskar, V. B. Baru Second edition Wiley India
4. Development of Entrepreneurship, G. S. Batra, Deep and Deep Publications, New Delhi

Guidelines for T.Y. B.Sc. Practical Courses

1. There are three practical courses per semester in CBCS pattern.
2. Each practical course consists of 8 experiments + one activity equivalents to 2 experiments or 2 additional experiments. There are TWO activities i.e. one for Practical course-I and other for Practical course-II per semester. The practical activity is a self -learning process.
3. The progress of the student activity will be assessed time to time/ weekly/ monthly by the teacher during regular practical timing.
4. Student has to submit full activity report individually, at the end of the semester. It will be evaluated both at internal and university practical examination.
5. The "activity concept" will allow students to carry out quality work and prepare good report (study material with practical experience) which will be useful to the teachers, departments, other students etc.
6. In the practical course examination, 20% weightage will be given to activity done by the student at internal and external examination.

The number of experiments according to groups is specified in the following Table.

Group	Title of Paper/Course	Number of Experiments
EL357: PRACTICAL COURSE I		
A	Analog circuit design and applications and Nanoelectronics	04
B	Optics and Fiber Optic Communication OR Electronic Product Design and Entrepreneurship	04
C	Activity/additional experiments	02
	Total Experiments	**10**
EL 358: PRACTICAL COURSE II		
A	Digital Design using Verilog	02
B	Microcontroller Architecture and Programming	03
C	C Programming	03
D	Activity/additional experiments	02
	Total Experiments	**10**

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EL 357: Paper VII: Practical Course I

SEMESTER V **CREDITS: 2**

There are 10 Experiments in Paper VII EL357 Practical Course- I
One activity as directed in practical course which will be equivalent to 2 experiments.

- Internal Practical Examination (Out of 15): Continuous Internal Assessment
  - 12 Marks for Experiment
  - 3 Marks for Activity
- University Semester Practical Examination (Out of 35): One experiment of 3 hours duration
  - 30 Marks for Experiment
  - 3 marks for oral
  - 2 marks for activity

Course Outcomes: After completing the course, the students will be able to
CO1: Analyze different design and test procedures for analog circuits and systems.
CO2: Measure different parameters of optical fiber communication systems
CO3: Understand importance of product design and entrepreneurship.
CO4: Develop electronic systems for given application.

LABORATORY EXPERIMENTS (Total 8 experiments)

Group A: Analog Circuit Design and Applications and Nanoelectronics (Any 4)

1. To design, build and test wave shaping circuits (Integrator / differentiator circuit)
2. To design, build and test Op-amp based clipper and clampers.
3. To design, build and test Log amplifier using Opamp
4. To study gain bandwidth product of inverting/ non-inverting amplifier.
5. To design, build and test Regulated power supply using IC 723 (Low and High Voltage,1A Current)
6. To design, build and test Function generator using 8038/2206 or any equivalent IC
7. To design, build and test second order Butterworth active Low Pass/ High Pass/ Band Pass/ Band Reject Filter (any two)
8. To study PLL and measure lock range and capture range of PLL (IC565/ CD4046/ XR2211 or any equivalent IC

Nanoelectronics:

1. Do it Yourself projects demonstrating nanoelectronics.

2. Simulation study of quantum dots using suitable programming language/simulation software.
3. Simulation study IV characteristics of nano devices like transistors etc. using suitable programming language/simulation software.
4. Study of flash memory.
5. Deposition of CdS layer using Spin coating.
6. Synthesis of the Silver nanoparticles by sol gel method.
7. Measurement of Electrical conductivity of thin films of different Nano-materials.

Group B (Optional paper): Optics and Fiber Optic Communication (Any 4)
Note: Use fiber optic demonstration kits
1. To measure propagation loss in optical fibers
2. To measure bending loss in optical fibers
3. To set up fiber optic voice link
4. To measure Numerical Aperture of given optical fiber.
5. To study different methods of optical fiber terminations and polishing
6. To study fiber optic sensors and their applications
7. To design, build and test fiber optic Transmitter
8. To design, build and test of fiber optic Receiver
9. Visit to telecom facility for observing splicing, alignment, fusing, OTDR operation, types of connectors, couplers and cables

Group B (Optional paper): Electronic Product Design and Entrepreneurship (Any 4)
1. Interview a successful entrepreneur
2. Visit a small business- project report.
3. Writing business proposal
4. Market Survey of electronic products
5. Quality control test procedures in industry
6. Study of methods from Prototype to product
7. Study of manufacturing process of any identified product

Group C: ACTIVITY: Any one of the following activities will be considered as equivalent to 2 experiments.
1. Any two additional experiments than specified from any Group.
2. Circuit Design and simulation using LTSPICE/Multisim.
3. Industrial /field Visit
4. Hands on training Workshop
5. Do it Yourself Open ended Project

RECOMMENDED BOOKS:
1. Operational Amplifiers, G. B. Clayton, MGHill publications
4. Optics and optical fiber communication, R. P. Khare, Oxford University Press,
5. Electronic Product Design, V. S. Bagad, Technical publications
6. National semiconductor manual

7. EXAR Manual/Signetics Manual

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EL 358: Paper VIII: Practical Course II

SEMESTER V **CREDITS: 2**

There are 10 Experiments in Paper VII EL358 Practical Course- II
One activity as directed in practical course which will be equivalent to 2 experiments

- Internal Practical Examination (Out of 15): Continuous Internal Assessment
  - 12 Marks for Experiments
  - 3 Marks for Activity
- University Semester Practical Examination (Out of 35): One experiment of 3 hours duration
  - 30 Marks for Experiment
  - 3 marks for oral
  - 2 marks for activity

Course Outcomes: After completing the course, the students will be able to
CO1: Develop and simulate design digital systems using Verilog.
CO2: Design and develop AVR microcontroller based systems.
CO3: Understand different nanoelectronic devices.
CO4: inculcate basic skills required for design and development of embedded Systems.

LABORATORY EXPERIMENTS (Total 8 Experiments)

Group A: Digital Design using Verilog (Any 2)
Note: One can use Xilinx 9i or updated versions for simulation. Use of behavioral/schematic modeling/gate level modeling styles are expected.
1. 2:1 Multiplexer and 1: 2 De-multiplexer
2. Magnitude comparator
3. Code converters
4. Binary Adder (Ripple Adder and carry look ahead adder)
5. Flipflops (R-S, J-K, T and D)
6. Counters. (Up counter/down counter, ring counter)
7. Shift Registers (SIPO/SISO/PISO/PIPO)
8. Sequence generator for stepper motor

Group B: Microcontroller Architecture and Programming (Any 3)
1. Simple programs: AVR programming in C using MPLAB or equivalent simulation software for arithmetic, logical operations, memory transfer etc.
2. Code conversions (Decimal to hex, hex to decimal, ASCII to hex , Hex to ASCII, BCD to 7 seg code)

3. Interfacing array of LEDs with AVR board
4. AVR C program to Read Push-button switch and display its status on LED.
5. Interfacing Buzzer with AVR Board.
6. Interfacing 7-Segment LED Display with AVR Board.
7. Interfacing of 16x2 LCD with Arduino board and display message on it.
8. Interfacing 4x4 matrix keyboard with AVR microcontroller.
9. Interfacing temperature sensor LM35measurement & display on LCD

Group C: C Programming (Any 3)

Write C Programs for following:

1. Generate the Fibonacci series up to the given limit N and also print the number of elements in the series
2. Find minimum and maximum of N numbers.
3. Find the GCD of two integer numbers.
4. Calculate factorial of a given number.
5. Find all the roots of a quadratic equation $Ax^2 + Bx + C = 0$ for non -zero coefficients A, B and C
6. Calculate the value of sin (x) and cos (x) using the Fourier series. Also print sin (x) and cos (x) value using library function.
7. Generate and print prime numbers up to an integer N
8. Sort given N numbers in ascending order using bubble sort.
9. Find the sum & difference of two matrices of order MxN and PxQ
10. Find the product of two matrices of order MxN and PxQ

Group D: ACTIVITY: Any one of the following activities will be considered as equivalent to 2 experiments

1. Any two additional experiments than specified from any Group
2. AVR based system design and simulation
3. Industrial /field Visit
4. Hands on training Workshop
5. Do it Yourself Open ended Project

RECOMMENDED BOOKS:

1. AVR Microcontroller using assembly and C, Muhammad Ali Mazidi, Serpnah Naimi and naimi, Pearson Publication
2. Verilog HDL: A Guide to Digital Design & Synthesis, Samir Palnitkar, SunSoft Press, ISBN: 978-81-775-8918-4.
3. Let us C, Yashwant Kanetkar, BPB publications
4. AVR Microcontroller Data sheet

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EL 359: Paper IX: Practical Course III(Project)

SEMESTER V **CREDITS: 2**

Course Outcomes: After completing the course, the students will be able to

CO1: Understand basic methodology of selection of topic for project.
CO2: Understand how to do literature review for selected topic for project.
CO3: Apply the knowledge for design and development of the selected project.
CO4: Use different software and hardware for testing, validation and verification of circuits for successful outcome of project
CO5: Understand documentation process in the form of presentation and project report
CO6: Understand process of systematic development of electronic system and Development of skills for successful outcome

Guidelines to conduct Practical Course III(Project)

Practical Course III is a project Course of 2 Credits.

- Internal Continuous Assessment (15 marks)
- University project Examination (35 marks)

This Course should be conducted using following guidelines:

a) In CBCS Pattern, Student has to perform project in Semester V as well as Semester VI. It can be :
   i. separate project for each semester OR
   ii. can perform continuous project carrying sufficient weightage of marks per semester.
b) There should be internal continuous assessment of Project work in the form of Seminars/presentation and continuous monitoring of work.
c) After completion of project, student has to submit the Project Report in the following format.
   i. Title of Project
   ii. Aim and objectives of project.
   iii. Literature or Reference work
   iv. Block diagram and its explanation in brief and/or algorithm of software required if any
   v. Design and development of Circuit/system and Simulation required if any
   vi. Circuit Diagram and its working and Program explanation if any
   vii. Experimental Work and PCB Design/fabrication required if any
   viii. Results and Discussion

ix. Applications
x. Future Scope
xi. References

c. There must be observations, interpretations, conclusions, results of the project work.
d. Algorithm, program strategy, module wise description of parts etc. be provided in case of projects related with development of computer software.
e. Applications, usefulness, student's contribution must be clearly specified.
f. Further extension work may be suggested for better outcome of the project.
g. It is recommended to present the projects in competitions / project exhibitions organized by various authorities.

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Skill Enhancement Course

ELSEC 351: Paper X: SEC1: Electronic Design Automation Tools

SEMESTER V **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to

CO1: Design the electronics circuits using EDA software tools
CO2: Simulate various analog and digital circuits using EDA software tools
CO3: Plot various waveforms.
CO4: Simulate basic electronic system blocks

Note: This course is to be conducted in laboratory for more hand on experience to students.

UNIT 1: Introduction to EDA Tools (6 LECTURES)

Definition of Simulation, Need of Simulation, Brief introduction of various simulators, Description to simulator tool, Hands on practice on available library of components, wiring and schematic designing

UNIT 2: Electronics Designing using LTSPICE/ PSPICE (10 LECTURES)

Introduction to Simulator: Brief History, New Versions, Representing Components, Understanding the simulation Environment, Using Model Editor, designing a Circuit and drawing a schematic, Preparation for Simulation: Preparing schematic for simulation, Understand the sources for simulation, Use of different markers. DC, AC, Transient and Fourier Analysis of circuit, Digital circuit Simulation.

Simulation Experiments:

- Simulation of clipper/clamper circuit/passive filter circuits.
- Simulation of transistor biasing circuit.
- Simulation of CE single/two stage amplifier circuit.
- Failure Mode Analysis of circuit.

UNIT 3: Introduction to Multisim/ CircuitMod (10 LECTURES)

Environment: Design Process, Setting environment preferences

The Multisim /CircuitMode : Schematic capture of circuits, Placing components, Wiring components, simulation and result display in MultiSim.

Device modeling: Design of Half-Wave rectifier, Bridge rectifier, clippers and clampers using diode, voltage regulator, AC voltage measurement, DC transfer curve analysis

Programs for Practice:

- Simulation of Half wave rectifier circuit.
- Simulation of Bridge Rectifier circuit
- Simulation of Voltage regulator circuit.

- Simulation of simple power circuit.
- Failure Mode Analysis of circuit.

UNIT 4: Introduction to Proteus/OrCAD (10 LECTURES)

Description of simulation software tools (OrCAD / Proteus), Schematic Description: Introduction, Input files, element values, Nodes, circuit elements, sources, output variables, format of circuit and output files, drawing the schematic, Design rule Check (DRC), Netlist details

Types of analysis: DC, Transient and Frequency.

Programs to Practice:

- Simulation of Active low pass/high pass/band pass/band stop filter
- Simulation of Wein bridge oscillator/function generator

RECOMMENDED BOOKS:

1. Essential Electronic Design Automation (EDA), by Mark D. Birnbaum,Pearson, ISBN: 0131828290

2. Electronic Design Automation for Integrated Circuits Handbook – 2, Scheffer Lavagno Scheffer Martin

3. http://www.linear.com/, http://www.expresspcb.com/http:/spice.sourceforge.net/

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ELSEC 352: Paper XI: SEC2: Internet of Things and Applications

SEMESTER V **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to
CO1: Know the basic building blocks of IoT
CO2: Know IoT protocols
CO3: Understand how to Design and Develop IoT based system through case studies.

Note: This course is to be conducted in laboratory as hands on experience to students.

UNIT 1: Introduction of IoT (6 LECTURES)

Definition and characteristics of IoT, Technical Building blocks of IoT, Devices, Communication Technologies, Physical design of IoT, IoT enabling technologies, IoT Issues and Challenges-Planning, Costs and Quality, Security and Privacy, Risks

UNIT 2: IoT Protocols (6 LECTURES)

MQTT, CoAP, XMPP and AMQT, IoT communication models, IoT Communication technologies: Bluetooth, BLE, Zigbee, Zwave, NFC, RFID, Zigbee etc.

UNIT 3: Health Care and Smart City applications of IoT (12 LECTURES)

Smart Healthcare: Characteristics of e-health and applications: monitoring of health parameters, smart medicine box, elderly people monitoring, challenges
Smart City: Characteristics and applications–Smart Economy, Smart People, Smart Goverence, Smart Mobility, Smart Environment, Smart Living, Smart Grid, Transport and Traffic Management

UNIT 4: Smart Home and Agriculture applications of IoT (12 LECTURES)

Smart Home: Characteristics of Smart Home, Smart Home Energy Management, Smart Appliances, Communication Technologies for Smart Homes, maintenance, security, challenges
Smart Agricultural: Characteristics and Applications, Scarecrow, Smart Irrigation System, Crop Water Management, Integrated Pest Management, Sensor-based field and resource mapping, Remote equipment monitoring

Experiments for Practice:

1. To interface LED/buzzer to Arduino/Raspberry pi and write a program to make it ON or OFF
2. To interface digital sensor/push button to Arduino/Raspberry pi and write a program to make LED ON when button pressed or sensor detection

3. To interface motor to Arduino/Raspberry pi and write a program to turn ON motor when push button is pressed
4. To interface DHT 11/any temperature sensor to Arduino/Raspberry pi and write a program to print temperature and/ or humidity.
5. To interface Bluetooth to Arduino/Raspberry pi and write a program to send sensor data to smartphone using Bluetooth
6. Write a program on Arduino/Raspberry pi to upload temperature and humidity data to Thingsspeak cloud.

RECOMMENDED BOOKS:

1. Internet of Things –A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515.

2. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, David Hanes, Cisco Press, ISBN-13: 978-1-58714-456-1, ISBN-10: 1-58714-456-5, 20173

3.The Internet of Things: Applications to the Smart Grid and Building Automation, Olivier Hersent, Omar Elloumi and David Boswarthick, Wiley, 97811199583453.

4.The Internet of Things –Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi ,Wiley,ISBN:978-1-119-99435-0

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EL 361: Paper I: Modern Communication Systems

SEMESTER VI **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to
CO1: Understand the digital modulation techniques.
CO2: Understand different types of pulse modulation techniques.
CO3: Describe the evolution and importance of Mobile communication and cellular communication
CO4: Know the basics of satellite communication systems.

UNIT 1: Basics of Digital Communication (06 LECTURES)

Introduction, digital trans receiver, Information capacity, bits, bit rate, baud rate and m-ary coding, Amplitude Shift Keying, Frequency Shift Keying, Binary Phase Shift Keying, Quadrature amplitude modulation, Block diagram of MODEM

UNIT 2: Digital modulation (10 LECTURES)

Definition of PCM, PCM Sampling, Signal to quantization noise, PCM Methods, Delta modulation and adaptive delta modulation and generation methods
Time Division Multiplexing, Frequency Division Multiplexing

UNIT 3: Mobile and Cellular Communication (10 LECTURES)

Introduction, mobile telephone service, cellular phone, frequency reuse, cell splitting, sectoring, segmentation and dualization, cellular telephone topology, roaming and handoffs, network components and call processing
Comparative study of GSM and CDMA, 2G, 3G and 4G concepts.

UNIT 4: Satellite Communication (10 LECTURES)

Introduction to satellite, geosynchronous satellites, spacing and frequency allocation, satellite system link models, system parameters, FDM satellite systems: Set-Top Box, channel capacity, satellite radio navigation, FDMA, TDMA, Satellite data communication: VSAT

RECOMMENDED BOOKS:

1. Electronic Communication Systems Fundamentals through advanced, Wayne Tomasi, Pearson Education Press
2. Wirelerss communications, Andrea Goldsmith, Cambridge University Press
3. Fundamentals of Wireless Communication, D. Tse and P. Viswanathan, Cambridge University Press.
4. Modern Wireless Communication, Haykin S. and Moher M., Pearson
5. Wireless and Mobile Network Architectures, Yi-Bing Lin Wiley.
6. WEB resources: http://nptel.ac.in/courses/

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EL 362: Paper II: Embedded System Design using Microcontrollers

SEMESTER VI **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to
CO1: Understand features and architecture of PIC microcontroller.
CO2: Demonstrate how to interface PIC microcontroller with different pheripherals
CO3: Understand features and architecture of ARM microcontroller.
CO4: Demonstrate embedded system using given microcontroller.

UNIT 1: Introduction to Embedded Systems (4 LECTURES)

Basic Concepts: Definition, Embedded system Vs general computing system, Purpose of embedded system, application areas, Elements of embedded system design-Real Time Operation, Memory footprint, reliability, size, cost.

UNIT 2: PIC16F887 Microcontroller (12 LECTURES)

Core features, Architecture, memory organization, I/O Ports, interrupts, addressing modes, instruction set

Interfacing PIC Microcontroller: LED, Switches, Solid State Relay, Seven Segment Display, 16x2 LCD display, 4x4 Matrix Keyboard, Digital to Analog Converter, Stepper Motor and DC Motor, Interfacing program examples using C language/python language

UNIT 3: ARM Microcontrollers (10 LECTURES)

Introduction to ARM based Microcontrollers, Architecture overview, status register, general purpose register file, memories, Instruction set, Simple programs using C Language/python language

UNIT 4: Embedded System case studies (10 LECTURES)

Washing Machine: Functional block diagram, Design and working
Automotive embedded system: Functional diagram, Design and working
Smart card technology, Digital Cameras

RECOMMENDED BOOKS:

1. Introduction to Embedded Systems, K. V. Shibu, TMH publication.
2. PIC microcontroller and embedded system, Muhammad Mazidi, Mackanly,Danny Causy Pearson Education Press
3. ARM Microcontrollers: Architecture, Programming, Interfacing and System Design, Rajkamal , Pearson Education Press
4. Embedded System Design, Rajkamal , Pearson Education Press

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EL 363: Paper III: Industrial Electronics

SEMESTER VI **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to

CO1: Understand basics of semiconductor power devices.

CO2: Analyze basic power electronics circuits and demonstrate applications.

CO3: Understand basics of motor control.

CO4: Understand basics of Electric Vehicle systems

Note: Emphasis should be given to input and output waveforms for single phase power circuits and characteristics of power devices

UNIT 1: Power Semiconductor Devices (8 LECTURES)

Comparative study of power devices (Diodes, Transistors, DIAC, TRIAC, Thyristors/SCR), Protection of power semiconductor devices. Triggering Methods using PUT

UNIT 2: Power Circuits (10 LECTURES)

Concept of three phase, Controller Rectifiers: Half wave and Full Wave (R Load and R/L load)
Inverters: Half bridge and full bridge, Cyclo converters

Concept of Switched Mode Power Supplies (SMPS), Various schemes of SMPS, Design aspects of SMPS, UPS

High frequency heating:

Induction Heating: Basic Principle, Factors Governing the process, applications, merits and demerits over other systems

Di-electric heating: Basic Principle, Factors governing the process, applications, merits and demerits over other systems

UNIT 3: Motor control (8 LECTURES)

Classification of motors, DC motor, Single phase SCR drive, Speed control of DC motor, AC motor and Induction motor

UNIT 4: Electric Vehicle (EV) systems (10 LECTURES)

Advantages of Electric Vehicles. Comparative study of EV and Hybrid Vehicles, Types of EVs: Battery Electric Vehicle (BEV), Plug in Hybrid Electric Vehicle (PHEV), Hybrid Electric Vehicle (HEV), Fuel Cell Vehicles, Electric Vehicle Batteries

Charging EV: Tickle charge, charging at home, Charging power station, High power stations

RECOMMENDED BOOKS:

1. Power Electronics: Circuits, Devices and Applications, Mohammad Rashid, Pearson publication.

2. Power Electronics, P.C. Sen TMH, New Delhi

3. Power Electronics and Its Applications, Alok Jain Penram India
4. Power Electronics, M D Singh, K B Khanchandani McGraw Hill, New Delhi
5. Thyrister & its applications , Ramamurthy East West Press, New Delhi
6. https://nptel.ac.in/courses/108/103/108103009/
7.https://pluginbc.ca/wp/wp-content/uploads/2014/07/EV-Beginners-Guide_Final_Sept2_2014.pdf

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EL 364: Paper IV: Manufacturing Processes for Electronics

SEMESTER VI **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to

CO1: Understand basics of Passive Electronic Component Manufacturing Processes

CO2: Understand process involved in PCB manufacture and Modern Circuit Assembly

CO3: Know about the Semiconductor Device and IC Fabrication Process

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UNIT 1 Passive Electronic Component Manufacturing Process (8 LECTURES)

Basic Manufacturing Processes of Electronic Passive components – Fixed value and Variable Resistors, Fixed value Capacitor, Fixed value Inductor, Transformer, Switches, Relays, Connectors and Cables

UNIT 2: PCB Manufacturing Process (10 LECTURES)

Parts of a PCB: Substrate, Copper Layer, Solder Mask, Silk Screen, Single, double and multilayer, PCB Manufacturing Process: Imaging desired layout on copper clad laminates, Etching or removing excess copper from inner layers to reveal traces and pads, Chemicals in PCB manufacturing, Creating the PCB layer stack up by laminating (heating and pressing) board materials at high temperatures, Drilling holes for mounting , through hole pins and vias, Automated Optical Inspection, PCB production equipment- Modern platers and etchers

UNIT 3: Modern Assembly Techniques for Electronic Systems (8 LECTURES)

Assembly Process for Surface Mount Technology (SMT), Thru-Hole Technology (THT) and Mixed Technology circuits - Solder Paste Stenciling, Pick and Place, Through-Hole Component Insertion, Automatic component insertion/placement systems, Vibratory insertion process for non-standard component insertion, Vision-guided assembly, Protection Against Electrostatic Damage, Manual Soldering, Reflow Soldering, Wave Soldering, Inspection and Quality Control.

Process flow for Hybrid Circuit Manufacturing (Thick film technology)

UNIT 4: Semiconductor Device and IC Fabrication Process (10 LECTURES)

Fabrication Steps for Semiconductor Devices - Crystal Growth, Thin Film Deposition, Oxidation, Diffusion, Ion Implantation, Lithography, Etching and Metallization, lead connection and encapsulation.

Process Integration and IC Manufacturing: Bipolar Technology, MOS/MES-FET Technology, Electrical Testing and Packaging

RECOMMENDED BOOKS:

1. Electronic Components and Materials: Principles Manufacture and Maintenance, S.M. Dhir, McGraw Hill
2. Passive Components for Circuit Design, Ian Sinclair, Elseveir Publications
3. Electronic Components, K. Padamanabhan and P. Swaminathan, Laxmi Publications
4. Electronic Components and Materials, Madhuri A. Joshi, SPD Publishing
5. Printed Circuit Boards: Design, Fabrication, and Assembly, R.S. Khandpur, Mcgraw Hill
6. Fundamentals Of Semiconductor Manufacturing and Process Control, Gary S. May and Costas J.,Wiley - IEEE)
7. Electronic Technology Handbook, Neil Sclater Mcgraw Hill

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EL 365: Paper V: Process Control Systems

SEMESTER VI **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to

CO1: Familiar with different types of sensors and related systems
CO2: Know different types of measurement systems.
CO3: Understand control parameters in process automation.
CO4: Understand different types of process control systems and their characteristics.

UNIT 1: Process Measurements (8 LECTURES)

Block diagram of instrumentation system, Analog and Digital Modes of Operation, Null and Deflection Methods, Input Output configuration of Instruments and measuring systems

UNIT 2: Process Performance Parameters (10 LECTURES)

Generalized measurement systems, zero-order System, First-order System, Second–order System, Dead-Time Element, Specifications and Testing of Dynamic Response.
Generalized Data Acquisition system- Elements of a data acquisition system, Single channel Data Acquisition system, Multichannel Data Acquisition system

UNIT 3: Fundamentals of Process Control (8 LECTURES)

Process control principles, Continuous control, discrete state control, composite discrete/continuous control, Process Characteristics, Control system parameters, Architecture of Industrial Automation Systems, Advantages and limitations of Automation

UNIT 4: Process Control Systems (10 LECTURES)

Two position mode, Multiposition mode, floating control mode
Continuous controller modes: Proportional control, Integral control, Derivative control
Composite modes: Proportional-Integral, Proportional derivative, Proportional-integral – derivative (PID)

RECOMMENDED BOOKS:

1. Process Control Instrumentation Technology; Curtis Johnson, Pearson Publication
2. Instrumentation Devices & Systems, C S Rangan,G R Sarma,V S Mani, TMH
3. Measurement Systems Application and Design, Ernest O Doeblin, Dhanesh N Manik, Tata McGrawHill
4. Elements of Electronic Instrumentation and Measurement, Joseph J. Carr, Pearson Education
5. Modern control technology: components & systems, Kilian, Delmar
6. Process software and digital networks, Bela G Liptak

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EL 366(A): Paper VI (A) : PLC and SCADA

SEMESTER VI **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to
CO1: Know about the basics of programmable logic controllers and their components.
CO2: Demonstrate PLC programming using ladder programming.
CO3: Develop PLC based systems by programming different components in PLC.

UNIT 1: Programmable Logic Controller (PLC) (6 LECTURES)

Introduction, Brief History, PLC Configurations, Typical system components, System block diagram

UNIT 2: Basics of PLC Programming (14 LECTURES)

Introduction, Basic components and their symbols: control transformers, fuses, Switches, Relays, Time delay relays, Indicator lamps

Fundamentals of Ladder diagrams: Basic diagram, Wiring, Boolean and relay logic, single cycle circuit, combined circuit. Machine control terminology, Physical components Vs Program components, Ladder program execution sequence, Mnemonic programming

Wiring Techniques: PLC power connection, Input wiring, output wiring, Relay outputs, Solid state outputs

UNIT 3: Introduction to SCADA (8 LECTURES)

Fundamentals of SCADA system, SCADA Hardware, SCADA software, SCADA and LAN, Comparative study of SCADA, DCS and PLC

UNIT 4: Components of SCADA system (8 LECTURES)

Block diagram of SCADA system, Advantages, Remote terminal Units (RTU), Typical requirements of RTU, SCADA Key features, Introduction to protocols, Case Study of SCADA applications

RECOMMENDED BOOKS:

1.Programmable Logic Controllers Programming Methods and Applications, John R. Hackworth and Fredrick D. Hackworth, Jr., Pearson Education
2. Practical SCADA for Industry, David Bailey BEng, Bailey and Associates, Perth, Australia
3. Programmable Logic Controllers, W. Bolton.
4. Programmable Logic Controllers, Frank D. Petruzella, Third Edition, Tata McGraw Hill Education Private Limited
5. Learning Programmable Logic Controllers with Applications, PK Srivastava, BPB Publications.

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EL 366(B): Paper VI (B): Sensors and Systems

SEMESTER VI **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to

CO1: Understand basic principles and types of different sensors.

CO2: Understand basic principles and types of actuators.

CO3: Know about signal conditioning systems for sensors.

UNIT 1: Fundamentals of Sensors (10 LECTURES)

Definition, Classification and types of sensors, Sensors: Temperature, stress and strain, light, chemical sensors, gas sensors, vibration sensors, smart sensors

Specification and performance parameters: Accuracy, Resolution, Threshold, impedance, noise, Sensitivity, Hysteresis, Linearity, Range, Reliability, Selectivity, bandwidth

UNIT 2: Introduction to Sensor Systems (8 LECTURES)

Sensor systems: Sensor characteristics, signal conditioning circuits, power supply, data acquisition and readout, measurement issues and criteria

Bridge amplifiers, Precision opamps characteristics for amplifiers, instrumentation amplifiers, isolation amplifiers

UNIT 3: Actuators (10 LECTURES)

Actuators-Principle, construction and specifications,

Pressure controller, flow control actuators (Valves), Power control devices, magnetic control device - Relay, Solenoid, Electromechanical: servo, DC motor, AC motor, Stepper motor

UNIT 4: Applications of Sensors (8 LECTURES)

Healthcare and biomedical applications, applications in building management system, industry, security and surveillance, marine, military and space

RECOMMENDED BOOKS:

1. Sensor technology handbook John Wilson, Elsevier
2. Fundamentals of industrial instrumentation and process control, William C. Dunn, Mc Gaw Hill Publication
3. Sensors and Transducers, D Patranabis, Prentice Hall Publication
4. Sensors and Transducers, Dr. A.D. Shaligram, Chintan Publication
5. Sensors and Transducers, Principles and Applications, R.Y. Borse, Adhyan Publishers and Distributers, New Delhi

Guidelines for T.Y. B.Sc. Practical Courses

1. There are three practical courses per semester in CBCS pattern.
2. Each practical course consists of 8 experiments + one activity equivalent to 2 experiments or 2 additional experiments. There are TWO activities i.e. one for Practical course-I and other for Practical course-II per semester. The practical activity is a self -learning process.
3. The progress of the student activity will be assessed time to time/ weekly/ monthly by the teacher during regular practical timing.
4. Student has to submit full activity report individually, at the end of the semester. It will be evaluated both at internal and university practical examination.
5. The "activity concept" will allow students to carry out quality work and prepare good report (study material with practical experience) which will be useful to the teachers, departments, other students etc.
6. In the practical course examination, 20% weightage will be given to activity done by the student at internal and external examination.

The number of experiments according to groups is specified in the following Table.

Group	Title of Paper/Course	Number of Experiments
EL 367: PRACTICAL COURSE I		
A	Industrial Electronics	04
B	Modern Communication Systems	04
D	Activity/additional experiments	02
	Total Experiments	**10**
EL 368: PRACTICAL COURSE II		
A	Embedded Systems using Microcontrollers	04
B	Fundamentals of Process Control Systems	02
C	PLC-SCADA Sensors and Systems	02
D	Activity/additional experiments	02
	Total Experiments	**10**

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EL 367: Paper VII: Practical Course I

SEMESTER VI **CREDITS: 2**

There are 10 Experiments in Paper VII EL367 Practical Course- I
One activity as directed in practical course which will be equivalent to 2 experiments.

- Internal Practical Examination (Out of 15): Internal Continuous Assessment
  - 12 Marks for Experiments
  - 3 Marks for Activity
- University Semester Practical Examination (Out of 35): One experiment of 3 hours duration
  - 30 Marks for Experiment,
  - 3 marks for oral
  - 2 marks for activity

Course Outcomes: After completing the course, the students will be able to
CO1: Demonstrate power electronic circuits.
CO2: Demonstrate different types of digital communication systems,
CO3: Understand working principles of different power devices and their characteristics

LIST OF EXPERIMENTS (Total 8 Experiments)

Group A: Industrial Electronics (Any 4)

1. To study Characteristics of power devices like BJT/MOSFET/IGBT/Triac
2. To design, build and test light dimmer circuit.
3. To design, build and test triggering circuit using PUT.
4. To study High frequency heating / induction heating
5. To demonstrate Class A/B/C/ D commutation circuit.
6. To design, build and test Single phase/Dual converter.
7. To design, build and test Half wave/Full Wave controlled rectifier.
8. To design, build and test 723/78xx voltage regulator.
9. To demonstrate SMPS/UPS
10. Comparative study of different types of EVs

Group B: Modern Communication Systems (Any 4)

1. To design, build and test PCM encoder.
2. To design, build and test Delta/Adaptive Delta modulation
3. Study of Satellite communication system
4. Comparative study of GSM, CDMA. 2G, 3G and 4G methods
5. Study of architecture of mobile communication system
6. Study QAM /QPSK techniques
7. Study of BPSK MODEM

Group C: ACTIVITY: Any one of the following activities will be considered as equivalent to 2 experiments

1. Any two additional experiments than specified from any Group
2. Circuit Design and simulation using LTSPICE/Multisim.
3. Industrial /field Visit
4. Hands on training Workshop
5. Do it Yourself Open ended Project

RECOMMENDED BOOKS:

1. Power Electronics: Circuits, Devices and Applications, Mohammad Rashid, Pearson publication
2. Electronic Communication systems, Kennedy and Davis, Mc Graw Hill
3. Smart Power Manual

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EL 368: Paper VIII: Practical Course II

SEMESTER VI **CREDITS: 2**

There are 10 Experiments in Paper VII EL368 Practical Course- II

One activity as directed in practical course which will be equivalent to 2 experiments.

- Internal Practical Examination (Out of 15): Internal Continuous Assessment
  - 12 Marks for Experiments
  - 3 Marks for Activity
- University Semester Practical Examination (Out of 35): One experiment of 3 hours duration
  - 30 Marks for Experiment,
  - 3 marks for oral
  - 2 marks for activity

Course Outcomes: After completing the course, the students will be able to
CO1: Design embedded systems using PIC microcontroller.
CO2: Design embedded systems using ARM microcontroller.
CO3: Demonstrate PLC SCADA using ladder programming.
CO4: Design and develop sensor systems for different applications.

LABORATORY EXPERIMENTS (Total 8 Experiments)

Group A: Embedded Systems using Microcontrollers (Any 4)
Write programs in embedded C/Python:
1. Simple Programs: arithmetic and logical operations using PIC/ARM
2. Interfacing LED/switch to PIC/ARM
3. Interfacing LCD to PIC/ARM
4. Interfacing sensors to PIC/ARM
5. Interfacing keyboard to PIC /ARM
6. Interfacing Bluetooth/wifi/Ethernet to PIC/ARM
7. Interfacing serial communication GSM to PIC /ARM

Group B: Fundamentals of Process Control Systems (Any 2)
1. Simulation of controller modes (P/PI/PD/PID)
2. Design and develop ON/OFF controller using microcontroller.
3. Ladder diagram programming for basic circuits
4. Study of process automation system using ladder diagram (Vending machine/bottle filling plant)
5. Design and Development of ON/OFF temperature control system using Arduino/Raspberry

Pi.

Group C: PLC SCADA (Any 2)

1. Ladder Programming for basic logic gates
2. Use of timers
3. Use of counters
4. Simulation of PLC SCADA system for bottle filling plant, traffic signal control systems
5. Comparative study of different PLC SCADA systems
6. Study of different components of PLC SCADA system
7. Creation of wiring diagram of basic PLC SCADA system using wiring diagram tool

OR

GROUP C: Sensors and Systems (Any 2)

1. Design, develop and test bridge amplifier for thermistor.
2. Design, develop and test Instrumentation amplifier for temperature measurement.
3. Design, develop and test signal conditioning circuit for optical sensors (LDR/Photodiode/Phototransistor)
4. Smoke detector
5. Soil moisture measurement
6. Burglar alarm
7. Study of Smart sensors

Group D: ACTIVITY: Any one of the following activities will be considered as equivalent to 2 experiments

1. Any two additional experiments than specified from any Group.
2. Circuit Design and Simulation using LTSPICE/Multisim
3. Industrial /field Visit
4. Hands on training Workshop
5. Do it Yourself Open ended Project

RECOMMENDED BOOKS:

1. Process Automation, C. D. Johnson, Pearson Education
2. PIC microcontroller and embedded systems using assembly and C Mazidi and Mazidi
3. ARM microcontroller, architecture and programming Rajkamal, Pearson publication
4. Sensor handbook
5. National semiconductor manual

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EL 369: Paper IX: Practical Course III(Project)

SEMESTER VI **CREDITS: 2**

Course Outcomes: After completing the course, the students will be able to

CO1: Understand basic methodology of selection of topic for project.
CO2: Understand how to do literature review for selected topic for project,
CO3: Apply the knowledge for design and development of the selected project.
CO4: Use different software and hardware for testing, validation and verification of circuits for successful outcome of project
CO5: Understand documentation process in the form of presentation and project report
CO6: Understand process of systematic development of electronic system and Development of skills for successful outcome

Guidelines to conduct Practical Course III(Project)

Practical Course III is a project Course of 2 Credits.

- Internal Continuous Assessment (15 marks)
- University project Examination (35 marks)

This Course should be conducted using following guidelines:

d) In CBCS Pattern, Student has to perform project in Semester V as well as Semester VI. It can perform
   iii. separate project for each semester OR
   iv. Can perform continuous project carrying sufficient weightage of marks per semester.
e) There should be internal continuous assessment of Project work in the form of Seminars/presentation and continuous work monitoring
f) After completion of project, student has to submit the Project Report in the following format
   xii. Title of Project
   xiii. Aim and objectives of project
   xiv. Literature or Reference work
   xv. Block diagram and its explanation in brief and/or algorithm of software required if any
   xvi. Design and development of Circuit/system and Simulation required if any
   xvii. Circuit Diagram and its working and Program explanation if any
   xviii. Experimental Work and PCB Design/fabrication required if any
   xix. Results and Discussion

xx. Applications
xxi. Future Scope
xxii. References

c. There must be observations, interpretations, conclusions, results of the project work.
d. Algorithm, program strategy, module wise description of parts etc. be provided in case of projects related with development of computer software.
e. Applications, usefulness, student's contribution in it must be clearly specified.
f. Further extension work may be suggested for better outcome of the project.
g. It is recommended to present the projects in competitions / project exhibitions organized by various authorities.

SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE
T.Y.B.Sc. ELECTRONIC SCIENCE
2021 PATTERN CBCS
Skill Enhancement course

ELSEC 361: Paper X SEC1: Design of Printed Circuit Boards

SEMESTER VI **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to

CO1: Understand basics of PCB.

CO2: Know about the PCB design technology.

CO3: Know about different soldering techniques.

Note: This course should be taught in laboratories for getting hands on experience

UNIT 1: PCB Fundamentals (6 LECTURES)

PCB Advantages, components of PCB, Electronic components, Microprocessors and Microcontrollers, IC's, Surface Mount Devices (SMD).

UNIT 2: Classification of PCB and Materials (10 LECTURES)

Types of PCB: Single, Double, Multilayer and flexible boards

PCB Materials: Copper, Standard FR-4 Epoxy Glass, Multifunctional FR-4, Tetra Functional FR-4, NelcoN400-6 ,GETEK ,BT Epoxy Glass ,Cyanate Aster , Plyimide Glass ,Teflon(explanation with reference to operating frequency of circuit),

Properties of laminates (electrical & physical) and types of laminates

UNIT 3: PCB Design Concepts (10 LECTURES)

PCB Designing Flow Chart: Schematic Entry, Net listing, PCB Layout Designing,

Prototype Designing: Design Rule Check (DRC), Design For Manufacturing (DFM) , PCB Making , Printing , Etching o Drilling , Assembly of components

Description of PCB Layers: Electrical Layers, Top Layer, Mid Layer, Bottom Layer, Mechanical Layers, Board Outlines and Cutouts, Drill Details Documentation Layers, Components Outlines, Reference Designation

Text Keywords and their Description: Footprint, Pad stacks, Vias, Tracks, Color of Layers, PCB Track Size Calculation Formula

UNIT 4: PCB layout design (10 LECTURES)

Tools for PCB Design: Understanding the schematic Entry, Creating Library and Components, Drawing Schematic, Flat Design / hierarchical Design, Setting up Environment for PCB Design a Board, Mechanical and Electrical design considerations, Placing and Mounting of components, Conductor spacing, heat sinks and package density

Auto routing: Introduction to Auto routing, Setting up Rules, Defining Constraints, Auto router Setup

Post Designing: Gerber Generation, Adding and Editing Pins.

PCB Technology: Trends, Environmental concerns in PCB industry.

Experiments for Practice:

1. PCB Designing of Basic and Analog Electronic Circuits
2. PCB Designing of Power Supplies
3. PCB Designing of Different Sensor modules
4. PCB Designing of Electronics Projects
5. PCB Designing of Embedded Projects

RECOMMENDED BOOKS:

1. Printed circuit Board –Design & Technology by Walter C. Bosshart, Tata McGraw Hill
2. Printed Circuit Board –Design, Fabrication, Assembly and Testing, R.S.Khandpur, TATA McGraw Hill Publisher

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2021 PATTERN CBCS
Skill Enhancement course

ELSEC 362: Paper XI: SEC2: Mobile Application Development

SEMESTER VI **CREDITS: 2** **LECTURES: 36**

Course Outcomes: After completing the course, the students will be able to
CO1: Understand basics of Mobile application development.
CO2: Develop ability to work in android development environment.
CO3: Design and develop mobile applications.

Note: This course should be taught in laboratories for getting hands on experience

UNIT 1: Android Concepts (10 LECTURES)

Introduction to Android, Versions of Android, Features of Android, Architecture of Android, Android Devices, Installation of Required tools: Android SDK, Android Development Tool (ADT)
Practice Program: Develop an Android Application to print Hello World

UNIT 2: Basics of Android Application Development (12 LECTURES)

Anatomy of an Android applications, Android terminologies, Android User Interface Design Essentials: Managing resources: data types, colors, images, tables, layouts, animation, media, User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation.
Practice Program: Develop an Android Application to change the color and size of font in text box by clicking buttons

UNIT 3: Android User Interface (8 LECTURES)

Layouts: Linear, Absolute, Table, Relative, Frame, Scroll view, Resize and reposition - Screen orientation , Views: Text view, Edit Text, Button, Image Button, Checkbox, Toggle Button, Radio Button, Radio Group, Progress Bar, Autocomplete Text, Picker, List views and Web view– Displaying pictures with views: Gallery and Image View, Image Switcher, Grid view – Displaying Menus: Helper methods, Option and Context
Practice Program: Develop an Android Application to emulate Simple Calculator
Practice Program: Develop an Android Application for viewing analog clock and digital clock

UNIT 4: Location Access and Publish Android Application (6 LECTURES)

Location based services: Display map, zoom control, view and change, Marking, Geocoding, Get location - Publish Android applications and Deployment
Practice Program: Develop an Android Application to display Web Page.
Practice Program: Develop an Android Application to send SMS from application,
Practice Program: Develop an Android Application to get data from Android Sensors,

RECOMMENDED BOOKS:

1. Android Wireless Application Development, T1. Lauren Darcey and Shane Conder, Pearson Education
2. Beginning Android Application Development, WeiMeng Lee ,Wrox Publications

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